

REMARKS/ARGUMENTS

Favorable reconsideration of this application in view of the following remarks is respectfully requested.

Claims 1-28 are presently active in this case, no claim amendments are made herein, and no change in claim scope is contemplated by the remarks contained herein.

In the outstanding Office Action, Claims 1-6, 27, and 28 were rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent Publication 2002/0148816 to Jung et al., and Claims 7-26 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Jung et al. in view of U.S. Patent No. 5,403,434 to Moslehi.

Applicants first note that Applicants' representative has attempted to schedule a personal interview with the Examiner Fuller, the assigned examiner in this case, by calling phone number 571-272-1420. However, the phone number is inactive and a personal interview has not resulted from Applicants' efforts. Therefore, Applicants respectfully request that the assigned Examiner contact the undersigned to schedule a personal interview prior to acting on this response.

Turning now to the merits, Applicants' invention is directed to an improved method for removing chamber residue from a plasma processing system in a dry cleaning process. As discussed in the background section of Applicants' specification, over time residues from plasma processes can accumulate in the process chamber and flake off thereby generating particle contamination in the process chamber and on processed substrates. Conventional dry cleaning methods for removing these contaminants were often ineffective, and typically required a substrate shield to shield sensitive materials of the substrate holder from the dry cleaning process. Applicants' invention is directed to improving the dry cleaning process and/or avoiding the requirement for using a substrate shield during the dry cleaning process.

Specifically, Applicants' Claim 1 recites a method of removing a chamber residue from a plasma processing system, the method including introducing a process gas including a gas containing carbon and oxygen into a process chamber of the plasma processing system, and generating a plasma from the process gas. Also recited is exposing the chamber residue to the plasma in a dry cleaning process to form a volatile reaction product, and exhausting the reaction product from the process chamber. Thus, Applicants' Claim 1 makes clear that the method applies to cleaning residues from a plasma processing system. Further a gas containing carbon and oxygen is introduced into the process chamber and a plasma is generated from this gas. The plasma constituents then react with the chamber residue to form a volatile reaction product and the reaction product is exhausted thereby removing the contaminant from the chamber. Claims 27 and 28 recite similar features in system and means plus function format.

In contrast, the cited reference to Jung et al. discloses a method of desmearing holes in a copper laminated printed circuit board, and forming a conductive material in the holes using an atmospheric pressure capillary discharge plasma apparatus. Thus, Applicants first note that the invention disclosed in Jung et al. is not directed to cleaning a chamber residue at all, but rather is directed to cleaning a workpiece, such as a PCB. Apparently recognizing this deficiency, the outstanding Office Action points to paragraph [0008] in the background of Jung et al. in support of an anticipation rejection of the independent claims of this application. Paragraph [0008] states as follows:

In an effort to overcome the above-discussed chemical method, a dry cleaning method such as a plasma has been proposed to remove contaminants without leaving residues. *During the plasma process, hydrocarbon contaminants are cracked in volatile products, such as water and carbon dioxide.* However, since the conventional plasma process should operate in a vacuum environment, it requires expensive vacuum systems and components. As a result, the conventional

plasma processing is still an expensive process in fabricating PCB.¹

Thus, paragraph [0008] simply refers to conventional plasma dry cleaning methods wherein the plasma “cracks” hydrocarbon contaminants into volatile products such as water and carbon dioxide. The carbon dioxide is a byproduct of the cleaning process, not a gas input to perform the cleaning. Indeed, there is no mention of the process gas that is ignited into a plasma in order to cause this “cracking.” Thus, paragraph 8 does not disclose introducing a process gas including a gas containing carbon and oxygen into a process chamber of the plasma processing system and generating a plasma from the process gas as required by Applicants’ independent Claims 1, 27 and 28.

Moreover, even assuming that the detailed description of Jung et al. relates to a method of cleaning a chamber of a plasma processing system, Jung et al. still does not disclose introducing a process gas including a gas containing carbon and oxygen as required by Applicants’ independent claims. Specifically, Jung et al. discusses the use of “any gas” and provides a list of gases none of which include both carbon and oxygen.² The only discussion of a gas including both carbon and oxygen is with respect to byproducts of the process after the process gas is introduced into the chamber and formed into a plasma. For example paragraph 42 explains that a chemical reaction between oxygen radicals and CF₄ and the resin generates CO₂, CO and HF. Applicants submit that this identification of byproducts does not meet the limitation of introducing a process gas into the chamber containing carbon and oxygen in order to clean the chamber as required by Applicants’ independent Claims 1, 27 and 28.

The secondary reference to Moslehi does not correct the deficiencies of Jung et al. Specifically, Moslehi discloses a dry cleaning process for removing a native oxide and/or

¹ See Jung et al. at paragraph [0008].

² See Jung et al. at paragraph [0037], for example.

contaminants from a semiconductor wafer. There is no discussion in Moslehi of cleaning residue from a process chamber. Further, the process gases disclosed in Moslehi for removing the native oxide from the substrate are halogen containing gases such HCl or HBr, and/or anhydrous HF gas. There is no disclosure in Moslehi of cleaning a process chamber or a substrate using a gas containing carbon and oxygen, as required by Applicants' independent Claims 1, 27 and 28.

For the reasons discussed above, Applicants' independent Claims 1, 27 and 28 patentably define over the cited references. As the remaining Claims 2-26 depend from Claim 1, these claims also patentably define over the cited references. Nevertheless, these dependent claims provide several features that further patentably distinguish the claims over the cited references.

For example, Claim 2 recites that the exposing step includes a waferless dry cleaning process. As noted above, both Moslehi and Jung et al. disclose cleaning a workpiece such as a printed circuit board or a substrate. Thus the cited references also do not disclose a waferless dry cleaning process. Applicants' Claim 5 recites that the process gas is at least one of carbon monoxide, carbon dioxide, an alcohol, and aldehyde or a ketone. As the cited references do not disclose the more general gas containing carbon and oxygen, the cited references also do not disclose the more specific gases recited in Claim 5. Still further, Applicants' Claims 8-10 recite different flow rates for the gas containing carbon and oxygen, which Applicants have determined to be particularly suitable for cleaning a process chamber as demonstrated in for example, Figures 5-7. Jung et al. does not disclose gas flow rates, and Moslehi discloses gas flow rates only with respect to processing a substrate, and not cleaning a process chamber. Applicants submit that this disclosure is insufficient for teaching the flow rates related to cleaning a process chamber as recited in Claims 8-10. Similarly, Claims 13-14 recite chamber pressures suitable for cleaning the process chamber. The cited reference to

Jung et al. discloses a process at atmospheric pressure, and Moslehi discloses chamber pressures for processing a substrate, rather than cleaning the chamber. Again Applicants submit that these chamber pressures cannot be attributed to the cleaning process of the claims.

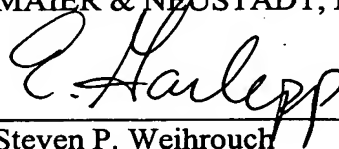
Finally, Applicants' Claims 19-26 recite features of a monitoring process for monitoring the cleanliness of a chamber undergoing the cleaning process using a gas containing carbon and oxygen. Neither Jung et al. nor Moslehi disclose such a monitoring process. Further, the outstanding Office Action fails to specifically address the limitations of Claims 19-26. Applicants respectfully request that any future Office Action should specifically state where in the prior art such features are disclosed.

Thus, the above dependent claims provide a further basis for patentability over the cited references.

Consequently, in view of the present amendment, no further issues are believed to be outstanding in the present application and the present application is believed to be in condition for formal allowance. An early and favorable action is therefore respectfully requested.

Respectfully submitted,

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